

# Improved Consistency of Slurry and Shell Properties using Particle Size Control of Ceramic Flours

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# Introduction



Hey Tom, look how this prime slurry is working!

How do you expect me to do a good job when the slurry drains like this?

## Sources of Variability

- Colloidal Silica/Polymer
  - a. Incoming properties
  - b. Aging in Drum. Closed, Open
- Makeup, Use, Age
  - a. Dispersion of flour particles
  - b. Bacteria, Contamination, Gravity, Slurry Tank
  - c. Friend --- Slurry turn over
- Flour Chemistry – Yttria, Alumina, Zircon
- Flour Particle size

# Particle Size Distribution of Flour

Has a large effect on the slurry because it is about 80% of the slurry

## Tabular Alumina Slurry

- Use equal parts of 200 and 325 mesh
- Shellbond 107

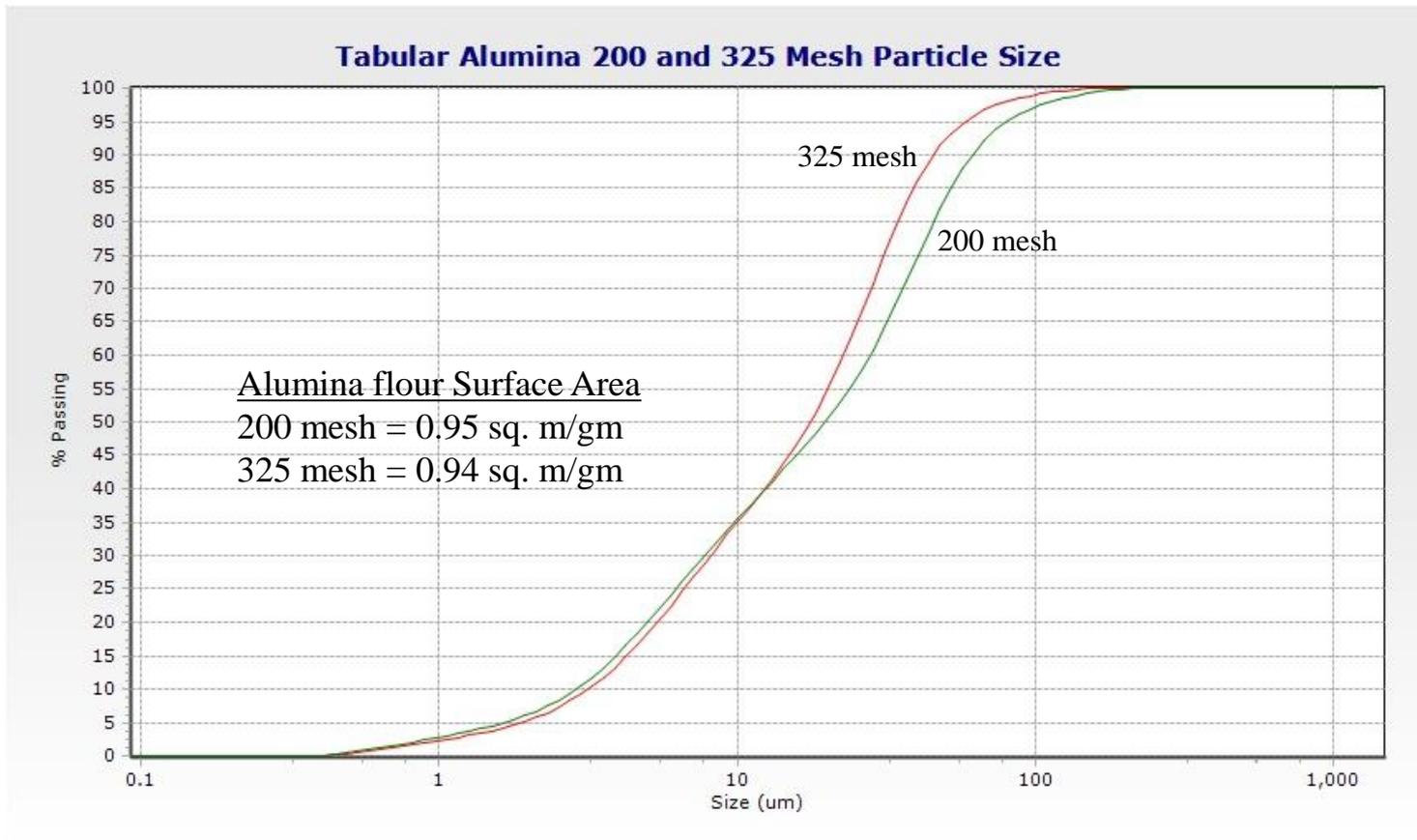


Table 1. Slurry Properties of Alumina Slurry

<u>Property</u>	<u>Units</u>	<u>200/325</u> <u>Slurry</u>	<u>Comments</u>
Zahn #5	Seconds	25.1	
Density	grams/cc	2.55	
Surface Tension	dynes/cm	32.4	
Plate Weight	grams	1.56	Buntrock Small Plate
Coating Thickness	mm	0.076	On glass slide

Note: Slurry did not drain well, kept dripping

**Why?**

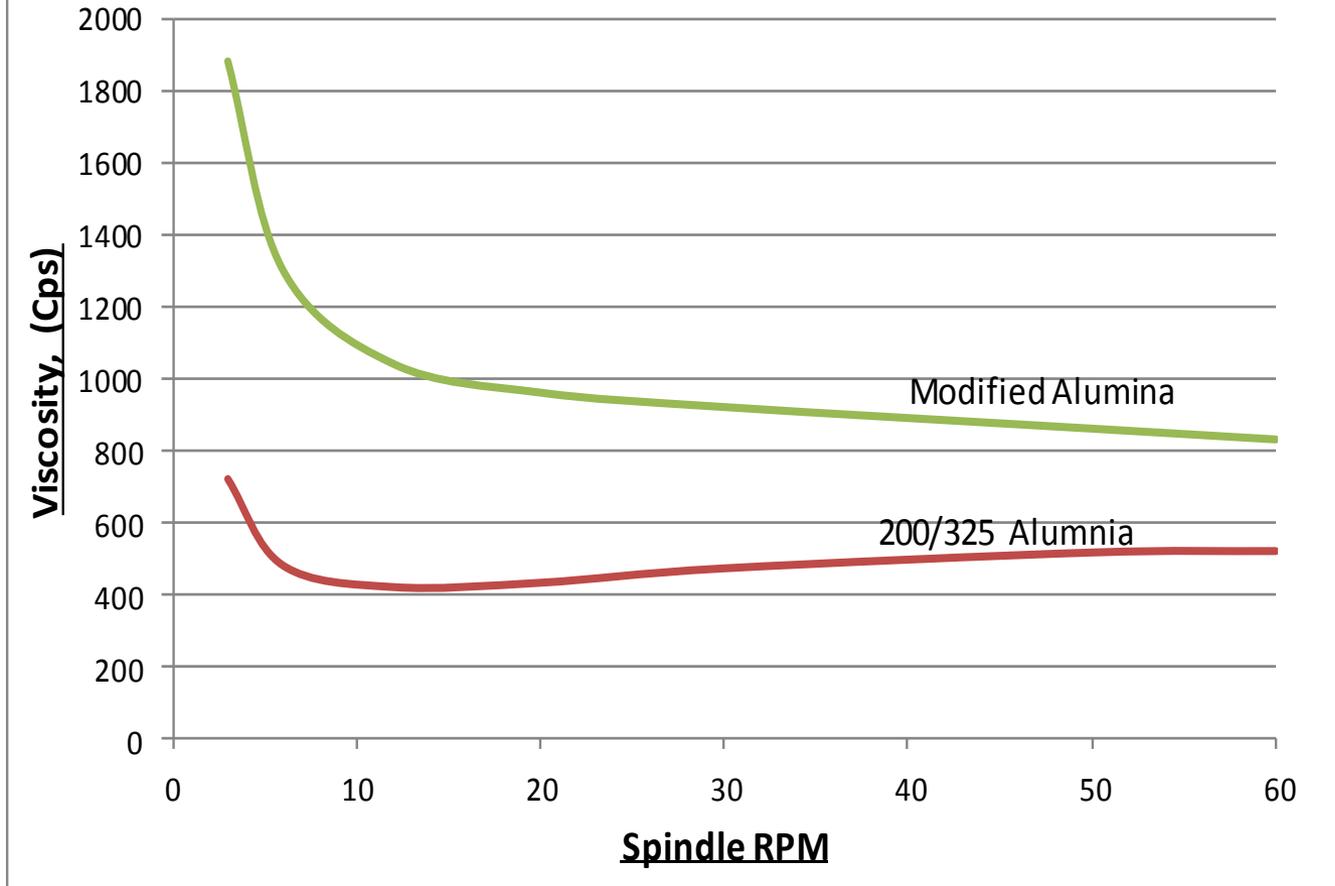
## Brookfield Viscometer



## #3 Spindle



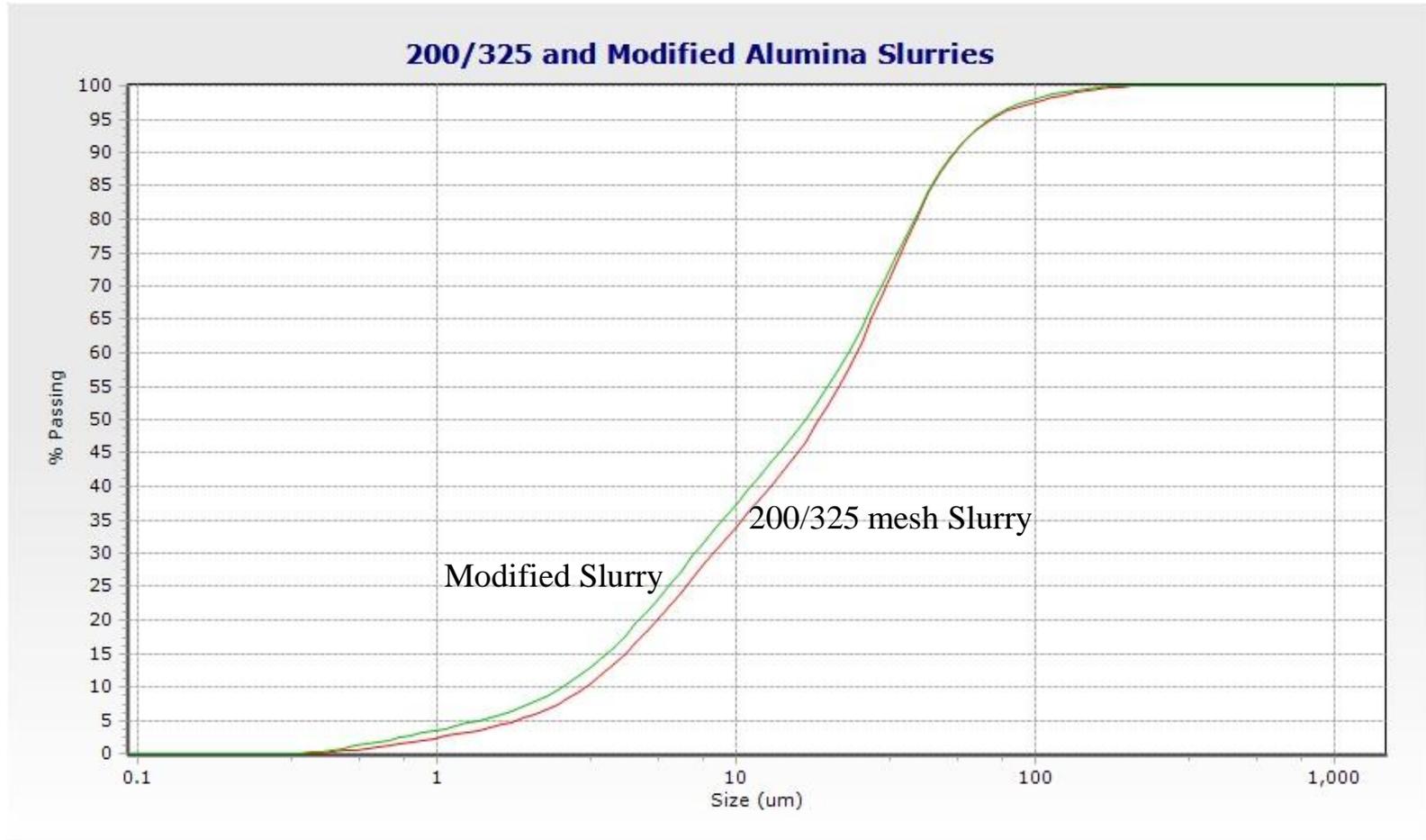
# Brookfield Viscosity of Original and Modified Alumina Slurries



# Slurry Modification: Add 6% fine Alumina

5 micron Avg. Particle Size

Surface Area = 3.36 sq.m./gm



## Slurry Property Comparison of 200/325 and Modified Slurries

Table 1. Slurry Properties of Alumina Slurry

<u>Property</u>	<u>Units</u>	<b>200/325</b> <u>Slurry</u>	<b>Modified</b> <u>Slurry</u>	<u>Comments</u>
Zahn #5	Seconds	25.1	25.0	
Density	grams/cc	2.55	2.64	
Surface Tension	dynes/cm	32.4	32.6	
Plate Weight	grams	1.56	1.72	Buntrock Small Plate
Coating Thickness	mm	0.076	0.092	On glass slide

Draining is much better.

## Discussion and Conclusions

- Small differences in particle size distribution can have an impact on slurry properties. Plate Weight, Slurry Density
- Slurries with equal Zahn viscosity, can be quite different in the way they flow and work in practice.
- A Brookfield Viscometer is useful to investigate rheology issues with slurries.
- Standard grade refractory powders may be suitable for many foundries, but not for more critical applications.
- Particle size curves presented are not recommendations, but for illustration purposes.
- Improved control and optimization of flour particle size distribution can be done. There is a cost associated with this effort. It is normally cost effective for higher value castings of Titanium and DS/SC aerospace applications.

*Thank you for your Attention!*

Questions?